International Journal of Accounting, Finance and Risk Management
2018; 3(4): 21-34
http://www.sciencepublishinggroup.com/j/ijafrm
doi: 10.11648/j.ijafrm.20180304.11
ISSN: 2578-9368 (Print); ISSN: 2578-9376 (Online)

SciencePG
Science Publishing Group

Research on Risk Assessment of Power Grid Enterprise Asset Management Based on the Life Cycle Cost Management Theory

Niu Dongxiao, Ma Bin*

School of Economics and Administration, North China Electric Power University, Beijing, China

Email address:

licheelily@ncepu.edu.cn (Niu Dongxiao), 1198184849@qq.com.com (Ma Bin)

*Corresponding author

To cite this article:

Niu Dongxiao, Ma Bin. Research on Risk Assessment of Power Grid Enterprise Asset Management Based on the Life Cycle Cost Management Theory. *International Journal of Accounting, Finance and Risk Management*. Vol. 3, No. 4, 2018, pp. 21-34.
doi: 10.11648/j.ijafrm.20180304.11

Received: October 16, 2018; **Accepted**: December 11, 2018; **Published**: January 14, 2018

Abstract: Based on the asset life cycle theory, this paper starts from the long-term economic benefits of the power company on the premise of ensuring the safety performance of the power grid. Through the construction of the risk indicator system, from the aspects of planning and planning process, procurement and construction process, operation and maintenance process, analyze the risk sources in a series of technical and economic measures in the organization, and divide the risk level of each part to help managers prepare for prevention more effectively, change or avoid technical risks. Finally, the asset management risk assessment model based on the matter-element expansion theory is used to empirically analyze the asset management risk of grid companies.

Keywords: Asset Life Cycle Theory, Power Grid, Risk Assessment Model, Asset Management

1. Introduction

France's Fayol was the first person to introduce the risk management idea into the business fields of production and management. *Administration Industrielle Et Générale*, written by Fayol, laid a foundation for the development of Risk Management Theory. Risk identification is the basis of risk management in the process of risk management. It refers to the identification of which risks will affect the occurrence of an event, and then records their characteristics as a document. Currently, the frequently-used risk identification technologies include brainstorming, checklist analysis, questionnaire and interview, Delphi Method, nominal group techniques and Causality Diagram, system dynamics, influence diagram analysis and other graphic techniques [1]. In recent years, Support Vector Machines (SVM), triangular fuzzy numbers, the analysis based on SWOT, and Hierarchical Holographic Modelings (HHM) [2] have also been gradually applied to the risk identification. Qin Ying proposed that the current concept of risk management has been transformed from a single, partial or separation level to the overall level of the enterprise [3]. Zhou Lijuan proposed a risk analysis for asset valuation and strengthened the consulting function of asset evaluation， Improving the evaluation management system and reducing trading risks [4]. Zhang Qiang established a fixed asset risk management platform based on big data construction grid enterprises, which will effectively identify the fixed assets risk of the power grid, improve the quality of power grid operation, and finally realize asset management [5]. Yang Jian's study towards the sources of asset assessment risks focuses on the imperfection of the legal system and the assessment personnel. It is proposed to speed up and improve the construction of related laws and regulations on asset assessment, set up a unified industry supervision mechanism, and establish expert advisory committees for the asset assessment, and etc [6]. Yang Ying started from the analysis of the concept, characteristics and types of asset evaluation, and proposed five measures to prevent risk assessment of assets. He believes that it is very important to improve the relevant supervision system [7]. Wang Haibing believes that risk assessment and asset management are the basic guiding principles for distribution companies to conduct various businesses. They have conducted detailed research on risk assessment, reliability assessment, asset management and maintenance strategies. [8].

Life Cycle Asset Management (LCAM) is the development of Life Cycle Cost (LCC) [9], LCAM is put forward through the application of LCC to the asset management. LCAM is a management method and concept that pursues the lowest life cycle cost. The concept fully considers the entire processes from the programming and planning, the procurement and construction, to the decommissioning disposal under the premise of satisfying efficiency, effectiveness and safety [10]. Zhang Xinyuan believes that the management of the life cycle of enterprise assets is a scientific and rational management philosophy that keeps pace with the times. In the development of enterprises, it is necessary to emphasize the management concept of "fine, process and intensive", so that enterprises can achieve high-level, high-efficiency and high-profit management mode in fixed asset management [11]. Tang Xiuying used the target tree method to establish strategic goals, comprehensive evaluation indicators, and the relationship between the process indicators of the management system, and realized the rational decomposition of the evaluation index system at the strategic level, management level and executive level, and formed an asset management evaluation system [12]. Wang Daidi believes that Chinese companies must change the past simple, single equipment or asset management concepts and methods, and use new theories and methods such as equipment comprehensive engineering and life cycle cost management to pay more attention to the cost of the entire equipment life cycle [13]. Chen Peiming believes that the life cycle management of power grid enterprise assets as a system project requires scientific and systematic management to achieve the optimization of the overall goal, and proposes overall adjustment and optimization from the perspectives of management objectives, management methods, rules and regulations [14]. Based on the life cycle cost management theory, they propose a quantitative analysis modeling for the preliminary planning of project assets, which provides the theoretical support and practical foundation for the smooth implementation of the planning and programming work of LCAM [15, 16].

2. The Construction of Asset Management Risk Index System

According to the company's asset management processes, risk sources are identified, and then a risk index system is constructed based on the risk sources, which relates to not only the indexes of each process of the company's asset management, but also the static and dynamic indexes, and the qualitative and quantitative indexes.

2.1. Risks Indexes in the Programming and Planning Process

The programming and planning stage includes the grid programming process, the project approval process, the investment planning process, and the preliminary designing process. The concerned sources of risks are the planning policies' risk source, the planning technology risk source, the planning environment's risk source, the budget risk source, the investment plan execution's risk source and the design work management system's risk source. The planning policies' risk source contains the tax policies' risk and the land policies' risk, among which tax policies' risk index is per capita tax amount and land policies' risk index is the land policies' influence, including the land using policies and the compensation policies towards land acquisition.

(1) The planning technical risk source contains the risk of equipment advancement and the environmental risk of equipment. And the risk index of equipment advancement is the rate of smart substations, and the environmental risk index of equipment is the growth rate of the grid-connected generation of clean energy.

(2) The planning environment's risk source contains the risk of uncertainty in electricity prices, the risk of uncertainty in on-grid energy, and the risk of uncertainty in the supply and demand of regions. Among them, the risk index of uncertainty in electricity price is the average transmission and distribution price; the risk index of uncertainty in on-grid energy on the grid is the growth rate of consuming capacity; and the risk index of uncertainty in regional supply and demand is the growth rate of cross-regional power output.

(3) The budget risk source contains the risk of uncertainty in benefit and the risk of budget execution. The benefit uncertainty's risk indexes are the main business' profit rate and the return on net assets, while the budget execution risk index includes the budget implementation's deviation rate.

(4) The risk source of investment plans' execution contains the risk of construction cost and the risk of plan adjustment. The construction cost's risk index is the cost of power transmission and distribution per kWh, and the plan adjustment's risk index is the rate of preliminary schemes' adjustment.

(5) The risk source of design work management system contains the risk of bid management and the risk of the compatibility degree with local plans. The design management's risk indexes are the design progress (the completion degree of projects) and the rationality of bid segmentation. And additionally the risk index of the compatibility with local plans is also include.

2.2. Risk Indexes in the Procurement and Construction Process

The procurement and construction phase includes the tender management process and the project construction process. Among them, the risk sources of the tender management process include the bidders' risk source and the bidding subjects' risk source; the risk sources in the construction process include the construction preparation's risk source and the civil construction's risk source.

(1) The bidders' risk source includes the risks of corporate strength and corporate integrity. The corporate strength's risk

index includes the implementation rate of material procurement standard; the corporate integrity's risk indexes include the timeliness rate of contract signings and the completion rate of material procurement plans.

(2) The bidding subjects' risk source includes the quality risk and the damaging risk of the subjects. And the quality risk index is the equipment life and the damaging risk index includes the equipment availability coefficient.

(3) The construction preparation's risk source includes the risk of the extension of construction duration and the risk of unqualified construction duration. And the risk indexes are the timely completion rate of projects and the deviation rate of the completion of comprehensive plan indexes.

(4) The civil construction's risk source includes the construction safety's risk and the construction environment's risk, in which the construction safety's risk index is the total number of personal safety incidents, and the construction environment's risk index is the natural risks in construction sites.

2.3. Risk Indexes in the Operation and Maintenance Process

The phase of operation and maintenance includes the operating and overhauling process and the spare parts' management process. The risk sources for the operating and overhauling process include the equipment operation's risk source and the line maintenance's risk source, while the risk sources for the spare parts' management process include the risk source of reserved facilities and the risk source of the spare parts' fixed demand.

(1) The equipment operating risk source includes the operational security risk, and its risk indexes are the total number of equipment safety incidents, the cost of operating and maintaining grid assets per 10,000 yuan, and the outage rate of equipment failures.

(2) The line maintenance's risk source includes the maintenance cost's risk and the transmission lines' risk. Among them, the maintenance cost's risk index is the total value of maintenance costs; the transmission line's risk indexes include the line tripping rate and the outage rate of power system breakdown.

(3) The reserved facilities' risk source includes the qualified rate of reserved facilities and the talent equivalent density.

(4) The spare parts' risk source includes the inventory turnover rate of spare parts and the transferring speed of spare parts.

2.4. Risk Indexes in the Decommissioning and Disposal Process

The decommissioning and disposal stage includes the technological renovation process and the disposal process of decommissioned assets. The risk sources of the technological transformation process include the risk source of feasibility studies towards technological renovation and the risk source of technological compatibility; the risk sources of decommissioned assets' disposal process include the risk source of the decommissioned equipment's status assessment and the risk source of decommissioned assets' disposal management.

(1) The risk source of feasibility studies towards technological renovation. The main risk indexes of it include the completion rate of technological reforming projects and the rate of the highly qualified technological renovation projects.

(2) The risk source of technological compatibility includes the compatibility risk of the primary equipment and the compatibility risk of the secondary equipment. The compatible primary devices include UHV, conventional energy, clean energy, energy storage devices, etc. The compatible secondary devices include protection devices, measurement devices, control devices, communication devices, software, and etc.

(3) The risk source of assessing retired equipment's status. The main risk indexes include the average life of decommissioned circuit breakers and the average life of decommissioned transformers.

(4) The risk source of retired assets' disposal and management. The risk indexes include the depreciation rate of fixed assets and the newness rate of retired assets.

The life cycle asset management risk indicator system is shown in the table.

Table 1. *The Risk Index System of the Corporate Asset Management.*

The Processes	Risk Sources	Risk Indexes
the programming and planning process A_1	the planning policies' risk source B_1	per capita tax amount C_1
		land policies' influence C_2
	the planning technical risk source B_2	the rate of smart substations C_3
		the growth rate of the grid-connected generation of clean energy C_4
	the planning environment's risk source B_3	the average transmission and distribution price C_5
		the growth rate of consuming capacityC_6
		the growth rate of cross-regional power output C_7
	the budget risk source B_4	the main businesses' profit rate C_8
		the return on net assets C_9
		the budget implementation deviation rate C_{10}
	the risk source of investment plans' execution B_5	the cost of power transmission and distribution per kWh C_{11}
		the rate of preliminary schemes' adjustment C_{12}
	the risk source of the design work management	the completion degree of projects C_{13}

The Processes	Risk Sources	Risk Indexes
the procurement and construction process A_2	system B_6	the rationality of the bid segmentation C_{14}
		the compatibility of land policies and local plans C_{15}
	the bidders' risk source B_7	the implementation rate of material procurement standard C_{16}
		the timeliness rate of contract signings C_{17}
		the completion rate of material procurement plans C_{18}
	the bidding subjects' risk source B_8	the equipment life C_{19}
		the equipment availability coefficient C_{20}
	the construction preparation's risk source B_9	the timely completion rate of projects C_{21}
		the deviation rate of the completion of comprehensive plan indexes C_{22}
	the civil construction's risk source B_{10}	the total number of personal safety incidents C_{23}
		the natural risks in construction sites C_{24}
the operation and maintenance process A_3	the equipment operation's risk source B_{11}	the total number of equipment safety incidents C_{25}
		the cost of operating and maintaining grid assets per 10,000 yuan C_{26}
		the outage rate of equipment failures C_{27}
	the line maintenance's risk source B_{12}	the total value of maintenance costs C_{28}
		the line tripping rate C_{29}
		the outage rate of power system breakdown C_{30}
	the reserved facilities' risk source B_{13}	the qualified rate of reserved facilities C_{31}
		the talent equivalent density C_{32}
	the spare parts' risk source B_{14}	the inventory turnover rate of spare parts C_{33}
		the transferring speed of spare parts C_{34}
the decommissioning and disposal process A_4	the risk source of the feasibility studies towards technological renovation B_{15}	the completion rate of technological reforming projects C_{35}
		the rate of the highly qualified technological renovation projects C_{36}
	the technological compatibility risk source B_{16}	the compatibility risk of the primary equipment C_{37}
		the compatibility risk of the secondary equipment C_{38}
	the risk source of assessing retired equipment status B_{17}	the average life of decommissioned circuit breakers C_{39}
		the average life of decommissioned transformers C_{40}
	the risk source of retired assets' disposal and management B_{18}	the depreciation rate of fixed assets C_{41}
		the newness rate of retired assets C_{42}

3. The Asset Management's Risk Assessment Model Based on the Matter-element Extension

3.1. Matter-element Extension Analysis Method

1). Matter-element

The matter N has the characteristic c, and v is the value of c. Then an ordered triad, $R=(N, c, v)$, consisting of N, c, and v, is used as the basic element for describing the matter N, simply called "matter-element".

The matter N has many characteristics, which can be described by n characteristics, $c_1, c_2, \cdots, c_n$ and corresponding values, $v_1, v_2, ..., v_n$. Thus, the resultant matter R is an n-dimensional matter-element, denoted as:

$$R=(N,C,V)=\begin{bmatrix} R_1 \\ R_2 \\ \vdots \\ R_n \end{bmatrix}=\begin{bmatrix} N & c_1 & v_1 \\ & c_2 & v_2 \\ & \vdots & \vdots \\ & c_n & v_n \end{bmatrix} \tag{1}$$

In the formula, $R_i=(N_i, C_i, V_i)$ present the sub-elements of R; $C=[c_1, c_2, ..., c_n]$ represent the eigenvector ; $V=[v_1, v_2, ..., v_n]$ represent the values of $C=[c_1, c_2, ..., c_n]$.

The idea of the matter-element evaluation method can be fully illustrated below. First of all, according to the existing data, the levels of the evaluated objects are divided into several grades. And next the data range of each grade is given by the database or according to expert opinions. Then the indexes of the evaluated objects are put into the collection of each grade to perform multiple index evaluation. The assessment results depend on the degree of correlation between the indexes and each collection. The greater the correlation degree is, the greater the degree of conformity is.

2). Evaluation Procedures

(1) The identification the matter-elements formed by the classical field, the segment field, and the to-be-identified objects.

$$R_j=(N_j, C_i, V_{ji})=\begin{bmatrix} N_j & c_1 & v_{j1} \\ & c_2 & v_{j2} \\ & \vdots & \vdots \\ & c_n & v_{jn} \end{bmatrix} \tag{2}$$

In the formula, N_j represents the divided j levels; $c_1, c_2, ..., c_n$ represent the n different characteristics of N_j; $v_{j1}, v_{j2}, ..., v_{jn}$ represent the value ranges of N_j in such aspects as $c_1, c_2, ..., c_n$, that is, the classical field. Let

$$R_p = (p, C_i, V_{pi}) = \begin{bmatrix} p & c_1 & \langle a_{p1}, b_{p1} \rangle \\ & c_2 & \langle a_{p2}, b_{p2} \rangle \\ & \vdots & \vdots \\ & c_n & \langle a_{pn}, b_{pn} \rangle \end{bmatrix} \tag{3}$$

In the formula, p represents the overall grades of the to-be-evaluated matters; $v_{p1}, v_{p2}, ..., v_{pn}$ represent respectively the value ranges of p in such aspects as $c_1, c_2, ..., c_n$, that is, the segment field of p. Let

$$R_0 = \begin{bmatrix} p_0 & c_1 & v_1 \\ & c_2 & v_2 \\ & \vdots & \vdots \\ & c_n & v_n \end{bmatrix} \tag{4}$$

In the formula, p_0 indicates the to-be-evaluated matter-element; $v_{p1}, v_{p2}, ..., v_{pn}$ represent respectively the specific data obtained from the tests towards p_0 in such aspects as $c_1, c_2, ..., c_n$.

(2) The normalization treatment

When the actual values of evaluated indexes exceed the segment field range, the correlation degree function can't be calculated. And in this case, the performance evaluation towards the power generation cannot be carried out by the matter-element extension method. In order to overcome this limitation, in this section, the values of the classical field matter-elements and the to-be-evaluated matter-elements are going to be normalized on the basis of the original matter-element extension method. They are divided by the right endpoint value b_{pi} of the segment field V_p, and then the new matter-element classical field and the new to-be-evaluated matter-element are obtained. The specific calculation is as follows:

$$R_j' = (Nj, C_i, V_{ji}') = \begin{bmatrix} p & c_1 & \left\langle \frac{a_{p1}}{b_{p1}}, \frac{b_{j1}}{b_{p1}} \right\rangle \\ & c_2 & \left\langle \frac{a_{j2}}{b_{p2}}, \frac{b_{j2}}{b_{p2}} \right\rangle \\ & \vdots & \vdots \\ & c_n & \left\langle \frac{a_{jn}}{b_{pn}}, \frac{b_{jn}}{b_{pn}} \right\rangle \end{bmatrix} \quad R_j' = (Nj, C_i, V_{ji}') = \begin{bmatrix} p_0 & c_1 & v_1 / b_{p1} \\ & c_2 & v_2 / b_{p2} \\ & \vdots & \vdots \\ & c_n & v_n / b_{pn} \end{bmatrix} \tag{5}$$

The calculation of correlation degree

Through the formula (5-21), the distance D between the new matter-element for appraising and the value range of the new classical field is calculated.

$$D(v, V_{ji}') = \left| v - \frac{a+b}{2} \right| - \frac{b-a}{2} \tag{6}$$

In the formula, v represents the point value; a and b represent respectively the left endpoint value and the right endpoint value of the interval.

$$K_{ji}(p_0) = 1 - \sum_{i=1}^{n} w_i Di_j \tag{7}$$

In the formula, w_i represents the index weight; $K_j(p_0)$ represents the overall correlative degree.

The grade assessment

If $K_j(p_0) = \max\{K_j(p_0)\} (j = 1, 2, ..., m)$, then the to-be-evaluated matter- element p_0 belongs to j grade. Let

$$\overline{K}_j(p_0) = \frac{K_j(p_0) - \min K_j(p_0)}{\max K_j(p_0) - \min K_j(p_0)} \tag{8}$$

$$j^* = \frac{\sum_{j=1}^{m} j \overline{K}_j(p_0)}{\sum_{j=1}^{m} \overline{K}_j(p_0)} \tag{9}$$

In the formula, j^* represents the variable eigenvalue of the risk level. From the size of j^*, the degree to which the to-be-evaluated matter-element is biased toward the adjacent grade can be judged.

3.2. The Standardization Treatment Towards Risk Indexes

In the asset management's risk assessment, the risk indexes are first standardized, and then people use the index weight distribution method to provide the basis for risk indexes' evaluation.

1). The uniformed treatment towards indexes

In general, among the indexes, $x_1, x_2, ..., x_n$, there may be four types: very large indexes, miniature indexes, intermediate indexes, and interval indexes. According to the different types, the index set $X = \{x_1, x_2, ..., x_n\}$ can be divided as follows:

$$X = \cup X_i, \text{ and } x_i \cap x_j = \Phi \tag{10}$$

In the formula, $X_i = \{i = 1,2,3,4\}$ signifies the very large index set, the miniature index set, the intermediate index set, and the interval index set. For the convenience of discussion, this article will uniformly treat all types of indexes as extremely large indexes. The specific treatment methods are as follows:

(1) The uniformed treatment towards miniature indexes. As for the miniature index x, let

$$x^* = \frac{1}{x}, (x \neq 0) \tag{11}$$

(2) The uniformed treatment towards intermediate indexes. As for the intermediate index x, let

$$x^* = \begin{cases} \dfrac{2(x-m)}{M-m}, \left(m \le x < \dfrac{M+m}{2}\right) \\ \dfrac{2(M-x)}{M-m}, \left(\dfrac{M+m}{2} \le x < M\right) \end{cases} \tag{12}$$

In the formula, m is an allowable lower bound for the index x; M is an allowable upper bound for the index x.

(3) The uniformed treatment towards interval indexes

$$x^* = \begin{cases} 1 - \dfrac{q_1 - x}{\max\{q_1 - m, M - q_2\}}, (x < q_1) \\ 1 \qquad , x \in [q_1, q_2] \\ 1 - \dfrac{x - q_2}{\max\{q_1 - m, M - q_2\}}, (x > q_2) \end{cases} \tag{13}$$

In the formula, $[q_1, q_2]$ is the most stable interval; M and m are the allowable upper and lower bounds for x respectively.

2). The dimensionless treatment of quantitative indexes

(1) Standard treatment method

$$x_{ij}^* = \frac{(x_{ij} - \overline{x}_j)}{s_j} \tag{14}$$

In the formula, x^*_{ij} is the standard observation value; $\overline{x}_j, s_j$ are respectively the sample mean and the sample mean square deviation for the j^{th} index's observation value.

(2) Extreme value treatment method

$$x_{ij}^* = \frac{x_{ij} - m_j}{M_j - m_j} \tag{15}$$

In which, $M_j = \max_i \{x_{ij}\}, m_j = \min_i \{x_{ij}\}$ 。

(3) Normalization

$$x_{ij}^* = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}} \tag{16}$$

The normalization method can be considered as a special case of the linear proportional method. Under the premise of $\sum_{i=1}^{n} xi_j > 0$, and when, $x^*_{ij} \in (0,1)$ has no fixed maximum and minimum value, and $\sum_{i=1}^{n} x^*_{ij} = 1$.

(4) Linear proportional method

$$x_{ij}^* = \frac{x_{ij}}{x_j^*} \tag{17}$$

In the formula, x^*_{ij} can take the minimum, the maximum or the average value of the index. When x_j^s takes the minimum value of the index, the value range of x^*_{ij} is $[1, +\infty]$; when x_j^s takes the maximum value, the value range of x^*_{ij} is $[-\infty, 1]$; when x_j^s takes the average value, the value range of x^*_{ij} is $[-\infty, +\infty]$.

(5) Vector standardized method

$$x_{ij}^* = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}} \tag{18}$$

The normalization method can be considered as a special case of the linear proportional method. When $x_{ij} > 0$, $x^*_{ij} \in (0,1)$ has no fixed maximum and minimum value, and $\sum_{i=1}^{n} (x^*_{ij})^2 = 1$.

(6) Efficiency coefficient method

$$x_{ij}^* = c + \frac{x_{ij} - m}{M_j - m_j} \times d \tag{19}$$

In the formula, M_j and m_j are respectively the satisfied value and the non-permitting value of the index x_j; *c* and *d* are already given. The role of *c* is to "translate" the transformed value, while the effect of *d* is to "amplify" or "reduce" the transformed value, typically taking *c*=60, *d*=40.

3). The dimensionless treatment of qualitative indexes

It is often encountered that qualitative indexes appear in the evaluation system. In order to form an organic evaluation system with quantitative indexes, the qualitative indexes should be standardized. The commonly used and relatively simpler method is to firstly use the subjective weight method to score the different indexes' descriptions, and then standardize them by the corresponding standard functions according to the indexes' attributes. And the evaluation values can also be directly calculated based on subjective scores.

3.3. The Distribution Model of Risk Index Weight

Traditional calculating models for evaluating the index weight mainly include the subjective weight distribution model based on the function-driven principle and the objective weight distribution model based on the difference-driven principle. The two kinds of weight distribution models can be divided into a variety of specific methods. For example, the subjective weight distribution model can be implemented by the set-valued iterative method, the eigenvalue method, and the sequence relations method, while the objective weight distribution model adopts the mean variance method, the variation coefficient method, and the entropy weight method.

The subjective weighting method based on the function-driven principle reflects appraisers' subjective judgment or intuition, while the objective weight distribution model, based on the difference-driven principle, uses the perfect mathematical theories and methods to calculate the weight. Thus, both have their own advantages. However, the comprehensive evaluation results of the subjective weight distribution model may be influenced by the subjective randomness of appraisers, while the objective weight distribution model ignores the subjective consciousness of appraisers. Thus, the conventional objective evaluation results often have some deviation from the real results. To overcome the above problems, this section proposes a weight distribution model based on Integrated Enduing Coefficients. The weight distribution model aims at minimizing the difference between the subjective and objective weightings. By optimizing the weighting coefficient, the final index weight is obtained, which makes the subjective information and the objective information of the evaluated index more consolidated.

Suppose that through the ANP method, the subjective weight vector of the enterprise asset management's risk assessment index is, $w' = \left(w_1', w_2', \ldots, w_n'\right)^T$, and it satisfies the formula, $w_j' \in [0,1]$, $\sum_{j=1}^{n} w_j' = 1$; And through the entropy weight method, the objective weight vector of the enterprise asset management's risk assessment index is calculated as: $w'' = \left(w_1'', w_2'', \ldots, w_n''\right)^T$, and it satisfies the formula, $w_j'' \in [0,1]$, $\sum_{j=1}^{n} w_j'' = 1$; The final weight vector obtained by weighting the subjective weight vector and the objective weight vector is:

$$w = \alpha w' + \beta w'' \tag{20}$$

Here, $\alpha, \beta > 0, \alpha + \beta = 1$.

To embody the subjective and objective information in the alternative ranking completely, considering that the weighted attribute value determined by the subject weight tends to be consistent with the weighted attribute value determined by the object weight, this paper establishes an optimization model of the coefficients α, β in the combined weight. According to the formula (3-26), under the attribute u_j, the subjective weighted attribute value of scheme a_i is $r_{ij}\alpha w_j$, and the objective weighted attribute value is $r_{ij}\beta w_j'$. Thus the difference between the subjective and objective weighted attribute values is $r_{ij}\alpha w_j - r_{ij}\beta w_j'$. Therefore, it can be drawn out that the deviation degree of the subjective and objective decision information of program a_i is:

$$d_i = r_{ij}\alpha_j w_j - r_{ij}\beta_j w_j' \tag{21}$$

Obviously, the smaller d_i is, the more consistent the subjective and objective decision-making information of the program is. Therefore, the optimization model can be constructed as follows:

$$\min D = \left(d_1, d_2, \ldots, d_m\right) \tag{22}$$

This is apparently a multi-objective decision programming problem. Since there is fair competition among various programs and there is no preference, so the above-mentioned multi-objective programming model can be transformed into the equivalent single-objective programming models as follows by the linear weighted sum method.

$$\min Z = \sum_{i=1}^{m} d_i = \sum_{i=1}^{m} \sum_{j}^{n} \left(r_{ij}\alpha_j w_j - r_{ij}\beta_j w_j'\right) \tag{23}$$

$$s.t. \alpha_j + \beta_j = 1\left(\alpha_j, \beta_j \ge 0\right) \tag{24}$$

4. The Empirical Analysis of Corporate Asset Management's Risk Assessment

Through the analysis of the company's asset management risks, an index system for asset management's risk assessment of a grid company is constructed. According to the four processes, the programming and planning process, the procurement and construction process, the operation and maintenance process, and the decommissioning and disposal process, the whole index system has a total of 18 secondary indexes and 43 tertiary indexes.

4.1. The Establishment of Risk Assessment Models

With reference to the historical data of a grid company's benchmarks, asset management's risk indexes of the company can be divided into five risk levels, as shown in the following table. Among them, N_1 represents the very high risk level; N_2 represents the relatively high risk level; N_3 represents the average risk level; N_4 represents the relatively low risk level; N_5 represents the very low risk level. And the corresponding colors are red, orange, yellow, blue, and green. The higher the score is, the higher the level is, and the lower level the risk is at. At the same time, the relevant index data of a grid company is selected as a sample for an empirical analysis. The following figure shows the risk indexes' levels and the sample data.

Table 2. *Risk Indexes' Levels and Sample Data.*

Index	per capita tax amount c_1	land policies' influence c_2	smart substations' rate c_3	the grid-connected generation of clean energy's growth rate c_4	the average transmission and distribution price c_5	consuming capacity's growth rate c_6
the standard value of a grid company's indexes	0.8844	0.6492	1	0.2371	0.6943	0.2509
very high risk level N_1	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
relatively high risk level N_2	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4
average risk level N_3	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6
relatively low risk level N_4	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8
very low risk level N_5	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1

Index	cross-regional power output growth rate c_7	the main businesses' profit rate c_8	the return on net assets c_9	the budget implementation deviation rate c_{10}	the cost of unit power transmission and distribution c_{11}	the rate of adjusting initial plans c_{12}
the standard value of a grid company's indexes	1	0.3224	0.951	0.991	1	0.8371
very high risk level N_1	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
relatively high risk level N_2	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4
average risk level N_3	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6
relatively low risk level N_4	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8
very low risk level N_5	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1

Index	projects' completion degree c_{13}	the bid segmentation's rationality c_{14}	conformity degree with local plan c_{15}	The implementation rate of material procurement standard c_{16}	the timeliness rate of contract signings c_{17}	The material procurement plans' completion rate c_{18}
the standard value of a grid company's indexes	0.9506	1	0.7316	1	1	0.8028
very high risk level N_1	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
relatively high risk level N_2	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4
average risk level N_3	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6
relatively low risk level N_4	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8
very low risk level N_5	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1

Index	The equipment life c_{19}	equipment availability coefficient c_{20}	the timely completion rate of projects c_{21}	the deviation rate of comprehensive plan indexes' completion c_{22}	the total number of personal safety incidents c_{23}	the natural risks in construction sites c_{24}
the standard value of a grid company's indexes	0.8204	0.7509	0.9519	0.3049	1	0.6937
very high risk level N_1	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
relatively high risk level N_2	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4
average risk level N_3	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6
relatively low risk level N_4	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8
very low risk level N_5	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1

Index	the total number of equipment safety incidents c_{25}	the cost of operating and maintaining the grid assets per 10,000 yuan c_{26}	the outage rate of equipment failures c_{27}	the total value of maintenance costs c_{28}	the line tripping rate c_{29}	the outage rate of power system breakdown c_{30}
the standard value of a grid company's indexes	0.2857	1	0.9643	0.174	0.8881	0.5094
very high risk level N_1	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
relatively high risk level N_2	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4
average risk level N_3	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6
relatively low risk level N_4	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8
very low risk level N_5	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1

Index	the qualified rate of reserved facilities c_{31}	the talent equivalent density c_{32}	the inventory turnover rate of spare parts c_{33}	the transferring speed of spare parts c_{34}	the completion rate of technical reforming projects c_{35}	the highly qualified rate of technical renovation projects c_{36}
the standard value of a grid company's indexes	0.9031	1	0.874	0.7912	0.9169	1
very high risk level N_1	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
relatively high risk level N_2	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4
average risk level N_3	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6
relatively low risk level N_4	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8
very low risk level N_5	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1

Index	the compatibility risk of primary equipment c_{37}	the compatibility risk of secondary equipment c_{38}	the average life of decommissioned circuit breakers c_{39}	the average life of decommissioned transformers c_{40}	the depreciation rate of fixed assets c_{41}	the newness rate of retired assets c_{42}
the standard value of a grid company's indexes	0.9662	0.82	0.8918	1	0.8659	0.5805
very high risk level N_1	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2	0-0.2
relatively high risk level N_2	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4	0.2-0.4
average risk level N_3	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6
relatively low risk level N_4	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8	0.6-0.8
very low risk level N_5	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1	0.8-1

The classical field of quantitative indexes in the above evaluation index system is given by experts' experience, and is set from 0% to 100%. The classical field of each risk level is in this range. For example, the classical field of some very high risk level indexes such as C_1 and C_2 is from 0 to 20%. And the classical field of relatively high risk level indexes is from 20% to 40%, and so on. Through expert surveys, qualitative indexes use a 10-point scoring system to identify. After the unification, the miniature indexes are converted into the very large ones. Then they are divided by 10, and the classical fields of five risk levels are successively ranked as 0-20%, 20%-40%, 40%-60%, 60%-80%, 80%-100%.

In the matter-element model, each risk level's values of the classical field matter-elements, R_1, R_2, R_3, R_4, R_5,, the segment field matter-elements R_p, and the to-be-evaluated matter-elements are as follows:

$$R_1=\begin{bmatrix} N_1 & C_1 & (0,20\%) \\ & C_2 & (0,20\%) \\ & \cdots & \cdots \\ & C_{41} & (0,20\%) \\ & C_{42} & (0,20\%) \end{bmatrix} \quad R_2=\begin{bmatrix} N_2 & C_1 & (20\%,40\%) \\ & C_2 & (20\%,40\%) \\ & \cdots & \cdots \\ & C_{41} & (20\%,40\%) \\ & C_{42} & (20\%,40\%) \end{bmatrix} \quad R_3=\begin{bmatrix} N_3 & C_1 & (40\%,60\%) \\ & C_2 & (40\%,60\%) \\ & \cdots & \cdots \\ & C_{41} & (40\%,60\%) \\ & C_{42} & (40\%,60\%) \end{bmatrix}$$

$$R_4=\begin{bmatrix} N_4 & C_1 & (60\%,80\%) \\ & C_2 & (60\%,80\%) \\ & \cdots & \cdots \\ & C_{41} & (60\%,80\%) \\ & C_{42} & (60\%,80\%) \end{bmatrix} \quad R_5=\begin{bmatrix} N_5 & C_1 & (80\%,100\%) \\ & C_2 & (80\%,100\%) \\ & \cdots & \cdots \\ & C_{41} & (80\%,100\%) \\ & C_{42} & (80\%,100\%) \end{bmatrix} \quad R_p=\begin{bmatrix} p & C_1 & (0,100\%) \\ & C_2 & (0,100\%) \\ & \cdots & \cdots \\ & C_{41} & (0,100\%) \\ & C_{42} & (0,100\%) \end{bmatrix}$$

In the formula, R_1、R_2、R_3、R_4、R_5 represent the classical fields; N_1 represents the very high risk level; N_2 represents the relatively high risk level; N_3 shows that the risk level is at an average level; N_4 represents the relatively low risk level; N_5 represents the very low risk level; R_p represents the segment field.

4.2. The Calculation of the Indexes' Correlation Degree

Since the index values of the asset management risk assessment of a grid company are within the scope of the classical field, the correlation degree can be calculated directly.

Table 3. *The correlation value of asset management's risk levels in a grid company.*

The index	Very large	Relatively large	Average	Relatively small	Very small
	D1 (vi)	**D2 (vi)**	**D3 (vi)**	**D4 (vi)**	**D5 (vi)**
C1	0.6844	0.4844	0.2844	0.0844	-0.0844
C2	0.4492	0.2492	0.0492	-0.0492	0.1508
C3	0.8	0.6	0.4	0.2	0
C4	0.0371	-0.0371	0.1629	0.3629	0.5629
C5	0.4943	0.2943	0.0943	-0.0943	0.1057
C6	0.0509	-0.0509	0.1491	0.3491	0.5491
C7	0.8	0.6	0.4	0.2	0
C8	0.1224	-0.0776	0.0776	0.2776	0.4776
C9	0.751	0.551	0.351	0.151	-0.049
C10	0.791	0.591	0.391	0.291	-0.009
C11	0.8	0.6	0.4	0.2	0
C12	0.6371	0.4371	0.2371	0.0371	-0.0371
C13	0.7506	0.5506	0.3506	0.1506	-0.0494
C14	0.8	0.6	0.4	0.2	0
C15	0.5316	0.3316	0.1316	-0.0684	0.0684
C16	0.8	0.6	0.4	0.2	0
C17	0.8	0.6	0.4	0.2	0
C18	0.6028	0.4028	0.2028	0.028	-0.028
C19	0.6204	0.4204	0.2204	0.0204	-0.0204
C20	0.5509	0.3509	0.1509	-0.0491	0.0491
C21	0.7519	0.5519	0.3519	0.1519	-0.0481
C22	0.1049	-0.0951	0.0951	0.2951	0.4951
C23	0.8	0.6	0.4	0.2	0
C24	0.4937	0.2937	0.0937	-0.0937	0.1063
C25	0.0857	-0.0857	0.1143	0.3143	0.5143
C26	0.8	0.6	0.4	0.2	0
C27	0.7643	0.5643	0.3643	0.1643	-0.0357
C28	-0.026	0.026	0.226	0.426	0.626
C29	0.6881	0.4881	0.2881	0.0881	-0.0881
C30	0.3094	0.1094	-0.0906	0.0906	0.2906
C31	0.7031	0.5031	0.3031	0.1031	-0.0969
C32	0.8	0.6	0.4	0.2	0
C33	0.674	0.474	0.274	0.074	-0.074
C34	0.5912	0.3912	0.1912	-0.0088	0.0088
C35	0.7169	0.5169	0.3169	0.1169	-0.0831
C36	0.8	0.6	0.4	0.2	0
C37	0.7662	0.5662	0.3662	0.1662	-0.0338
C38	0.62	0.42	0.22	0.02	-0.02
C39	0.6918	0.4918	0.2918	0.0918	-0.0918
C40	0.8	0.6	0.4	0.2	0
C41	0.6659	0.4659	0.2659	0.0659	-0.0659
C42	0.3805	0.1805	-0.0195	0.0195	0.2195

Through the calculation, the correlation degree of the grid company's asset management risk levels is:

$$K_1(p)=1-\sum_{i=1}^{42}\omega_i D_{ij}=0.428 \quad K_2(p)=1-\sum_{i=1}^{42}\omega_i D_{ij}=0.616 \quad K_3(p)=1-\sum_{i=1}^{42}\omega_i D_{ij}=0.76 \quad K_4(p)=1-\sum_{i=1}^{42}\omega_i D_{ij}=0.875$$

$$K_5(p)=1-\sum_{i=1}^{42}\omega_i D_{ij}=0.913$$

Because of $K_5(p)=\max K_j(p), j=(1,2,3,4,5)$, it can be drawn that a grid company's asset management risk level is low.

4.3. The Assessment of the Level of Each Risk Source

At the same time, the above matter-element extension model is used to carry out risk assessment towards the risk sources in each process. And the evaluation results are displayed in the risk map with the risk assessment method. E.g:

In the programming and planning process, the risk assessment towards the planning policies' risk source is made, and it can be concluded that the risk level is relatively low.

$$K_1(p_{B1}) = 1 - \sum_{i=1}^{2} \omega_i D_{ij} = 0.48024 \quad K_2(p_{B2}) = 1 - \sum_{i=1}^{2} \omega_i D_{ij} = 0.68024 \quad K_3(p_{B3}) = 1 - \sum_{i=1}^{2} \omega_i D_{ij} = 0.88024$$

$$K_4(p_{B4}) = 1 - \sum_{i=1}^{2} \omega_i D_{ij} = 1.00912 \quad K_5(p_{B5}) = 1 - \sum_{i=1}^{2} \omega_i D_{ij} = 0.91976$$

The risk assessment towards the planning technology risk source is made, and it can be concluded that the risk level is relatively high.

$$K_1(p_{B2}) = 1 - \sum_{i=3}^{4} \omega_i D_{ij} = 0.65774 \quad K_2(p_{B2}) = 1 - \sum_{i=3}^{4} \omega_i D_{ij} = 0.78226 \quad K_3(p_{B2}) = 1 - \sum_{i=3}^{4} \omega_i D_{ij} = 0.74226$$

$$K_4(p_{B2}) = 1 - \sum_{i=3}^{4} \omega_i D_{ij} = 0.70226 \quad K_5(p_{B2}) = 1 - \sum_{i=3}^{4} \omega_i D_{ij} = 0.66226$$

The risk assessment towards the planning environment risk source is made, and it can be concluded that the risk level is relatively low.

$$K_1(p_{B3}) = 0.6219 \quad K_2(p_{B3}) = 0.7826 \quad K_3(p_{B3}) = 0.8226 \quad K_4(p_{B3}) = 0.8581 \quad K_5(p_{B3}) = 0.73808$$

The risk assessment towards the budget risk source is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B4}) = 0.458 \quad K_2(p_{B4}) = 0.658 \quad K_3(p_{B4}) = 0.733 \quad K_4(p_{B4}) = 0.7629 \quad K_5(p_{B4}) = 0.8521$$

The risk assessment towards the investment plan execution's risk source is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B5}) = 0.2643 \quad K_2(p_{B5}) = 0.4643 \quad K_3(p_{B5}) = 0.6643 \quad K_4(p_{B5}) = 0.8643 \quad K_5(p_{B5}) = 1.0146$$

The risk assessment towards the design work management system's risk source is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B6}) = 0.3003 \quad K_2(p_{B6}) = 0.5003 \quad K_3(p_{B6}) = 0.7003 \quad K_4(p_{B6}) = 0.9003 \quad K_5(p_{B6}) = 0.9992$$

The risk assessment towards the bidders' risk source is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B7}) = 0.2657 \quad K_2(p_{B7}) = 0.4657 \quad K_3(p_{B7}) = 0.6657 \quad K_4(p_{B7}) = 0.8573 \quad K_5(p_{B7}) = 1.0093$$

The risk assessment towards the bidding subjects' risk source is made, and it can be concluded that the risk level is relatively low.

$$K_1(p_{B8}) = 0.4144 \quad K_2(p_{B8}) = 0.6144 \quad K_3(p_{B8}) = 0.8144 \quad K_4(p_{B8}) = 1.0144 \quad K_5(p_{B8}) = 0.9857$$

(9) The risk assessment towards the construction preparation's risk source is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B9}) = 0.5069 \quad K_2(p_{B9}) = 0.7069 \quad K_3(p_{B9}) = 0.7508 \quad K_4(p_{B9}) = 0.7908 \quad K_5(p_{B9}) = 0.8308$$

The risk assessment towards the civil construction risk source is made, and it can be concluded that the risk level is relatively low.

$$K_1(p_{B10}) = 0.4144 \quad K_2(p_{B10}) = 0.6144 \quad K_3(p_{B10}) = 0.8144 \quad K_4(p_{B10}) = 1.0056 \quad K_5(p_{B10}) = 0.9256$$

The risk assessment towards the equipment operation risk sources is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B11}) = 0.4619\ K_2(p_{B11}) = 0.6520\ K_3(p_{B11}) = 0.7133\ K_4(p_{B11}) = 0.7747\ K_5(p_{B11}) = 0.8360$$

The risk assessment towards the line maintenance's risk source is made, and it can be concluded that the risk level is at an average level.

$$K_1(p_{B12}) = 0.6776\ K_2(p_{B12}) = 0.8020\ K_3(p_{B12}) = 0.8820\ K_4(p_{B12}) = 0.8095\ K_5(p_{B12}) = 0.7224$$

The risk assessment towards the reserved facilities' risk source is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B13}) = 0.2620\ K_2(p_{B13}) = 0.4620\ K_3(p_{B13}) = 0.6620\ K_4(p_{B13}) = 0.8620\ K_5(p_{B13}) = 1.0620$$

The risk assessment towards the spare facilities' risk source is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B14}) = 0.3674\ K_2(p_{B14}) = 0.5674\ K_3(p_{B14}) = 0.7674\ K_4(p_{B14}) = 0.9674\ K_5(p_{B14}) = 1.0326$$

The risk assessment towards the technical feasibility studies' risk sources is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B15}) = 0.2456\ K_2(p_{B15}) = 0.4456\ K_3(p_{B15}) = 0.6456\ K_4(p_{B15}) = 0.8456\ K_5(p_{B14}) = 1.0456$$

The risk assessment towards the technical compatibility risk source is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B16}) = 0.3069\ K_2(p_{B16}) = 0.5069\ K_3(p_{B16}) = 0.7069\ K_4(p_{B16}) = 0.9069\ K_5(p_{B16}) = 1.0269$$

The risk assessment towards the retired equipment status assessment's risk source is made, and it can be concluded that the risk level is very low.

$$K_1(p_{B17}) = 0.2541\ K_2(p_{B17}) = 0.4541\ K_3(p_{B17}) = 0.6541\ K_4(p_{B17}) = 0.8541\ K_5(p_{B17}) = 1.0459$$

The risk assessment towards the retired asset disposal management's risk source is made, and it can be concluded that the risk level is relatively low.

$$K_1(p_{B18}) = 0.5053\ K_2(p_{B18}) = 0.7053\ K_3(p_{B18}) = 0.9053\ K_4(p_{B18}) = 0.9619\ K_5(p_{B18}) = 0.8947$$

On the basis of the various risk sources, the risk of each process of the grid company is rated. As shown in the following table, the risk level of the programming and planning process is relatively low, and the risk level of the procurement and construction process is very low. And then the risk levels of the operation and maintenance process and the decommissioning and disposal process are both very low.

Table 4. *Risk Levels in Each Process of the Grid Company.*

The Risk Level	Very high	Relatively high	Average	Relatively low	Very low
Programming and Planning Process	0.49	0.667	0.7685	0.8482	0.8443
Procurement and Construction Process	0.4118	0.6118	0.7652	0.913	0.9293
Operation and Maintenance Process	0.4677	0.6421	0.7645	0.8411	0.8864
Decommissioning and Disposal Process	0.3408	0.5408	0.7408	0.8976	0.9955

The risk levels and the influence degree of the risk sources and the asset management processes of the grid company are respectively and visually displayed in the risk map, as shown in the figure.

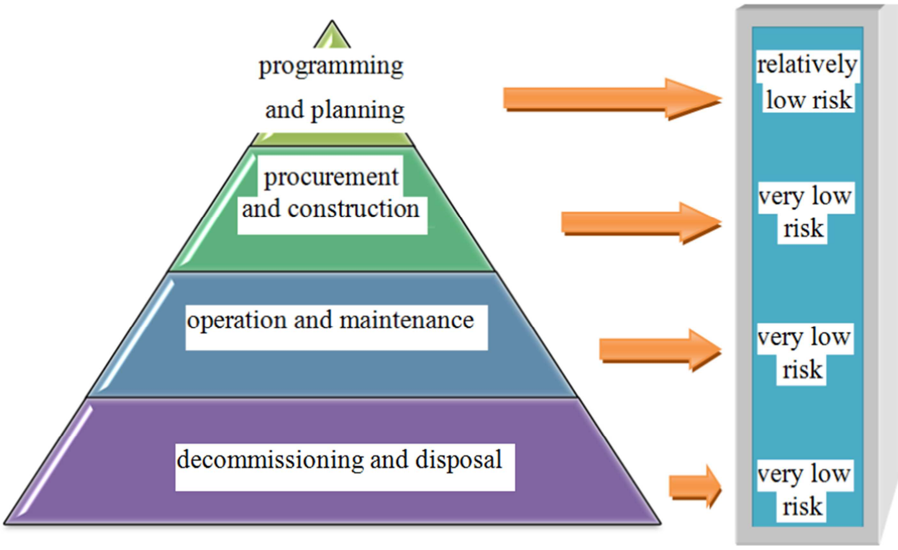

Figure 1. *The Risk Levels of All Processes in the Grid Company.*

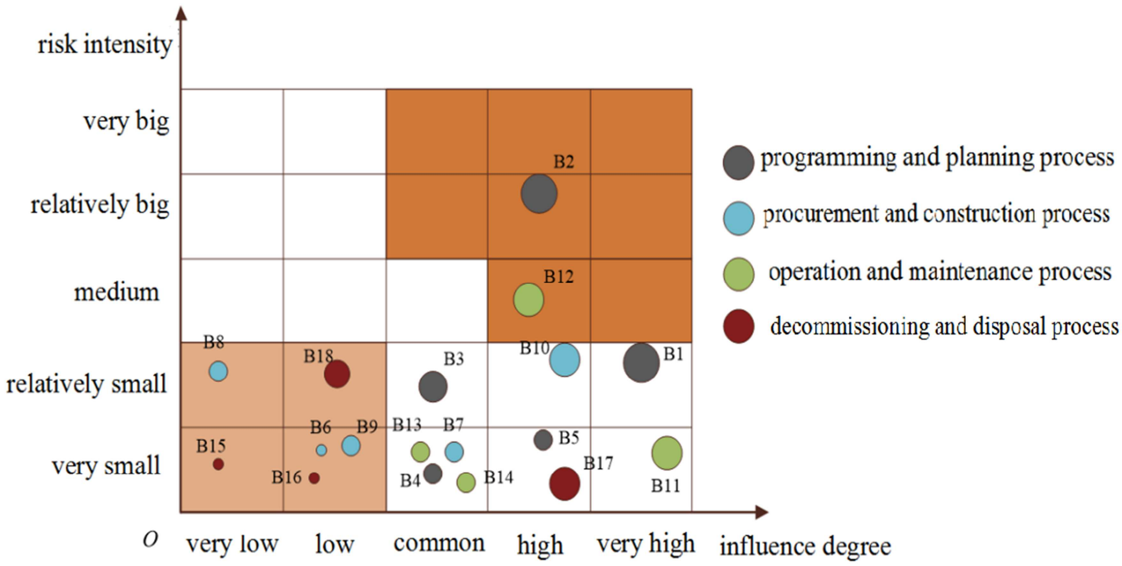

Figure 2. *An example of a grid company's risk sources in a risk map.*

From the above risk map, it can be seen that the risk level of each process of the grid company is relatively low or very low, in which the programming and planning process has a higher risk level than the other processes in the life cycle of asset management. And it is found in the risk assessment of risk sources that the risk intensity of the planning technology risk source is relatively big, which suggests that in assets' management, the company should do well preventive work to transfer or evade planning technology risks.

5. Conclusion

This article first elaborates the theory of asset life cycle and then applies it to the electric power field. Then based on this theory and starting from the long-term economic benefits of the company, by constructing a risk index system, this article carries out an analysis towards risk sources' indexes in a series of technical and economic organizational measures, and in the four processes, that is, the programming and planning process, the procurement and construction process, the operation and maintenance process. Finally, the asset managements risk's assessment model based on the matter-element extension theory is used to conduct an empirical analysis of the asset management risks in a grid company. Under the premise of ensuring the security performance of the grid, the risk indexes of each stage of the company are quantitatively analyzed, and the risk levels are divided at each part. The purpose is to help managers understand the company more clearly and directly, and also to prepare for prevention more efficiently so as to shift or evade the planning technology risks.

References

[1] Ahmed, Nazim U. A Design and Implementation Model for Life Cycle Cost Management System [J]. Information&Management, 1995 (4): 67-81.

[2] Cai Ling. Implementing the Concept of Life Cycle Cost Management [J]. Account, 2006 (9): 69-71.

[3] Qin Ying. Research on Risk Management Optimization of AB Power Company [J]. Enterprise Reform and Management, 2017 (14).

[4] Zhou Lijuan. Risk Analysis and Suggestion of Assets Evaluation Management [J]. Chinese and Foreign Entrepreneurs, 2018 (01): 24.

[5] Zhang Qiang. Discussion on Risk Management of Fixed Assets in Power Grid Enterprises [J]. Fiscal Supervision, 2017 (12): 112-116.

[6] Pan Xuemo. The Analysis of Asset Assessment Risks' Categories [J]. Appraisal Journal of China, 2000 (3).

[7] Yang Ying, Wang Haidong. Study on the risk assessment of China's assets and its preventive measures [J]. China High-tech Enterprise, 2016 (12): 193-194+130.

[8] Wang Haibing, Fan Mingyuan, Wang Chengmin, Xie Ning, Zhang Zuping. Research on Risk Assessment and Asset Management of No. 1 Distribution Network [J]. Supply and Electricity, 2016, 33 (05): 32-37.

[9] Wang Haisu, Wen Hao, Zhang Shiru. The Identification of Asset Assessment's Risks and the Prevention System [J]. Appraisal Journal of China, 2002 (6).

[10] Wang Xiudong, Tu Shuzhen, Zhao Banghong. Risks Prevention and Control of Assets Assessment [J]. Journal of Hebei Agricultural University, 2002 (1).

[11] Zhang Xinyuan. Discussion on the Life Cycle Management of Fixed Assets in Electric Power Enterprises [J]. Trade Practice, 2018 (17): 229.

[12] Tang Xiuying. Research on Evaluation Index of Asset Life Cycle Management System [J]. Low Carbon World, 2017 (32): 263-264.

[13] Wang Daidi, Feng Xiaoxing. Construction of Asset Life Cycle Management System [J]. Inner Mongolia Science Technology and Economy, 2017 (10): 40-41.

[14] Chen Peiming. Problems and Countermeasures of Life Cycle Management of Power Grid Enterprise Assets [J]. Finance and Economics (Academic Edition), 2015 (11): 43+45.

[15] Yang Jian. The Assessment Risk and Its Prevention [M]. Business Economy, 2012.

[16] Yang Zhihai. The Rational Thoughts on the Risk Prevention towards Assets Evaluation [J]. Journal of Fujian Commercial College, 2005 (5).